

CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

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SECTION I - GENERAL DESCRIPTION

1. GENERAL

1.01 This circuit contains the subscriber line relays, the line switches, and the line link frame junctor switches. It also contains the line link marker connector control circuit, jacks, and cords for traffic usage recording of subscribers lines, service observing jack circuit, and cord and test line jack circuit.

1.02 For calls from the lines it provides 10 outlets called links to junctor switches and 100 outlets called junctors from the junctor switches to trunk link frames. This provides each line with access to all trunk link frames for the purpose of connection to originating registers, outgoing trunks, intermarker group trunks, and intraoffice trunks.

1.03 When paired line link operation is provided access is provided to the junctors of the mate frame under traffic overflow conditions.

1.04 For calls to the lines it provides access via the same junctors and links for incoming trunks, intermarker group trunks, and intraoffice trunks, on all trunk link frames.

1.05 Connections to the markers are made via line link marker connectors and from the markers via line link connectors. On dial tone calls, however, both marker connectors, and frame connectors are closed to provide all of the leads required.

1.06 Where line insulation test equipment is provided it is introduced between one of the nonspecial markers and its connection to all line link frame connectors. With this arrangement the line link frame connector multiple of the nonspecial marker is wired from the line link frames to the marker by way of the line insulation test control circuit. When insulation testing is in progress this marker is made busy and the line insulation test control circuit uses this multiple to set up the connection on the line link frame. If an "all marker busy" condition exists for 5 to 8 seconds, line insulation testing is automatically suspended and the "made-busy" marker is restored to service. When the traffic peak has passed, the marker is again automatically made busy and insulation testing is resumed.

2. FRAME LAYOUT

2.01 The ten combined line and junctor switches on a basic line link frame are switches of 20 verticals with junctors to trunk link frames connected to the left 10 verticals and lines connected to the right 10 verticals.

2.02 Line links connect between the horizontal multiples of the right and left 10 verticals according to the slip pattern shown in FS103. The select magnets associated with these switches are multiplexed as shown in FS104.

2.03 The line links are loaded with traffic to the proper degree by extending the horizontal multiple of the line switch of the combined line and junctor switches to additional line switches. These may be mounted on the same frame or on supplementary frames. A variety of basic and supplementary frame sizes are available so that the number of lines may be from 190 to 590 in 50 line increments the remaining 10 line switch verticals being used for no-test purposes. The several combinations are shown in FS101.

2.04 Several of the sizes employ split frames, an arrangement not used on the replaced U-type equipments. Split frames accommodate line switches associated with two adjacent line link frames. On the split supplementary frames the lower five switches are associated with the frame to the left and the upper five switches are associated with the frame to the right. On the 190-line basic frame the lower five switches are associated with that frame and the upper five switches are associated with a basic frame having only combined line and junctor switches.

2.05 The line verticals, hold magnets, and associated line relays are subdivided as indicated in FS102. Three subdivisions are made: horizontal group, vertical group, and vertical file.

2.06 On nonsplit frames a horizontal group consists of all the lines on all the switches of the same number, and are the switches whose horizontals are multiplexed. Switches number from 0 to 9 from the bottom of the frame up. On split frames the horizontals on each switch are also split so that half of the verticals are in one horizontal group and the other half in another. Here the left hand of each group of five switches are numbered 0-4 and the right half 5-9.

2.07 Also, on nonsplit frames a vertical file consists of ten verticals, one in each of the ten horizontal groups and in the same position on each switch. Five successive vertical files comprise a vertical group except in vertical group 2 where the first file is used for no-test purposes. Vertical groups are number 0-11. On split frames a vertical file consists of five verticals on the left half of the upper or lower five switches, that is in horizontal groups 0-4 and five verticals in corresponding positions on the right half of the upper or lower five switches, that is in horizontal 5-9. Vertical groups on the split frames follow the same pattern, the five 10 vertical switches having one vertical group and the 20 vertical switches having two vertical groups.

2.08 A line group consists of the five verticals, line hold magnets and associated equipment common to one vertical group and one horizontal group. These line groups are numbered 0-11 according to the vertical group in which they appear and the line relays and associated hold magnets in each line group are numbered 0-4.

2.09 In some cases where the number of lines on a frame could be increased beyond the size originally selected it is possible to add a split supplementary to provide the additional lines. However, while an increase from the 190-line to 240-line size is thus accomplished, an increase from a 240- to 290-line size is not feasible since the 290-line size employs an entirely different basic frame.

2.10 Not more than eight select magnets shall be operated in multiple. The actual number will vary with the makeup of the line frames. In counting the number of select magnets in multiple it should be noted that when there are split supplementary frames in combination with nonsplit frames each split supplementary frame will contribute one line select magnet (L) to the total but each nonsplit frame (which includes the 200-line half of the basic frame) will contribute two line select magnets to the total.

2.11 This can be seen in FS105. When there are no split supplementary frames, each frame contributes only one line select magnet to the total in multiple. There will be a maximum of two combined line junctor (LJ) magnets regardless of the type or number of supplementary frames.

2.12 Provision is made for increasing the size of the existing U-type line link frames by the use of wire spring split supplementary frames and the interconnection of these frames shown in FS105 and FS106.

2.13 Range extension is provided on a horizontal group basis. Any number from one to all horizontal groups can be equipped with range extension. Each horizontal group equipped for range extension extends the tip, ring, and sleeve leads from the line switch in the line link circuit to a CI relay in the range extender circuit. The leads tip, ring, and sleeve return to the junctor switch in the line link.

3. GENERAL FUNCTIONS

3.01 The line link frame is involved in setting up three major kinds of connections. These are:

- (a) connection between a calling subscriber and an originating register,
- (b) connection between a calling subscriber and an intraoffice, inter-marker group, reverting call or outgoing trunk, and
- (c) a connection between a called subscriber and an intraoffice, inter-marker group or incoming trunk.

The line link frame also is used by the line insulation test control circuit to connect to the lines under test. Certain other circuits such as intercepting trunks, incoming and 2-way tandem trunks, and junctor circuits also terminate on the line link frame.

CONNECTION BETWEEN CALLING SUBSCRIBER AND ORIGINATING REGISTER

3.02 Operation of the subscriber line relay marks the line location and causes the line link frame to start for a marker through the line link marker connector. When the marker is attached it identifies the horizontal group and vertical group. On this type of call the marker also obtains access to the line link frame through the frame connector and over leads through this connector further identifies the calling line by obtaining the vertical file. A class-of-service indication is also passed to the marker through the connector.

3.03 The marker also has access to the line links and select and hold magnets so that it may test and set up a channel through a line link, junctor, and trunk link to an originating register. The hold magnet acts as a cutoff relay and releases the line relay, the connection being held through the sleeve crosspoints by the register. When the connection is established the marker disconnects and the frame and connector relays are released.

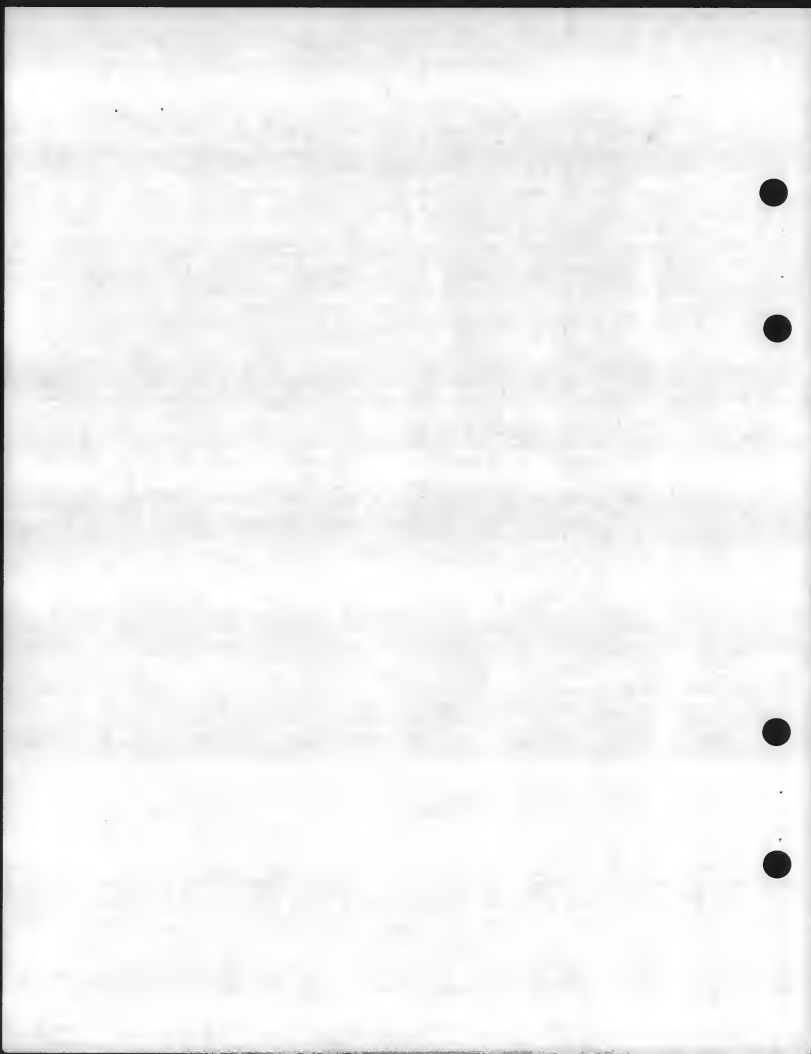
CONNECTION BETWEEN CALLING SUBSCRIBER AND INTRAOFFICE, INTERMARKER GROUP, REVERTING CALL, OR OUTGOING TRUNK

3.04 When the subscriber completes dialing into the originating register, the register connects to a marker through the originating register marker connector and passes to it both calling line location and called number information. The marker connects to the indicated line link frame through the line link connector and operates the vertical group, horizontal group, and line group relays to obtain access to the line links and switch magnets. The marker selects an idle channel between the trunk selected and the calling line, causes the register to release its connection to the line and then closes down the magnets to connect the line to the trunk. Reoperation of the line relay when the register releases

the line hold magnet is not permitted to give a new marker start. When the marker completes its function it disconnects and the connector and frame relays restore to normal.

CONNECTION TO CALLED SUBSCRIBER FROM INTRAOFFICE, INCOMING, OR INTERMARKER GROUP TRUNK

3.05 The marker obtains the called subscriber number from the originating register on intraoffice calls, from the incoming register on incoming calls, or from the intermarker group sender on intermarker group calls. The marker then connects to the number group to find the location of the hold magnet of the line in terms of line link frame tens and units, vertical group, horizontal group, and vertical file. After connection to the indicated frame through the line link connector, the marker operates the vertical group, horizontal group, and line group relays to gain access to the line hold magnet and the line links. The line is tested and if idle, the marker selects an idle channel between the trunk and called line and closes down the magnets to connect the trunk to the line. When the marker has completed its functions it disconnects, and the connector and frame relays restore to normal.



SECTION II - DETAILED DESCRIPTION1. CONNECTION BETWEEN ORIGINATING LINES
AND REGISTER (DIAL TONE CONNECTOR SC1)LINE RELAY OPERATES (FS1 AND 2)

1.01 When a line relay operates over the subscriber loop or to ground on the ring, it operates a VGS relay associated with the vertical group in which the line relay appears. (See 5.01 through 5.04 for operation of a VGS relay when line load control options are provided.) Relay VGS operates VT, grounds a VGT lead to the line link marker connector and connects battery through resistances STA and STB to the two marker connector start circuits.

CONNECTION TO MARKER THROUGH LINE
LINK MARKER CONNECTOR

1.02 Two circuits, used alternately, are provided to operate a marker start relay MS- in the preference control circuit. One or the other of these is closed by VGS- depending on whether relay Z in the connector control circuit is operated or normal, the position of Z being changed on alternate calls. Assuming Z normal, VGS- connects battery through resistance STA, through control relays TC, Z, TRS, and TR or TRL to the MSA terminal. Relay MSA is cross-connected to the MS- terminal for the first preferred marker. This circuit is known as the "A" start circuit and is sometimes referred to simply as STA. A "B" start circuit is similarly closed when Z is operated from battery through the STB resistance, through control relays TC, Z, TRS, and TR or TRL to the MSB terminal. The MSB is cross-connected to the MS- terminal for the marker which has been chosen as second preferred by the connector.

1.03 Operation of the MS- relay results in closing the connector multicontact relays MA and MB which close a number of leads between the marker and line link frame.

1.04 Marker relays OC1 or OC2 are connected to the marker start leads for the purpose of holding the connector under control of the marker. After checking the continuity of these leads OC1 operates TC (FS4) or OC2 operates TC1.

MARKER FINDS VERTICAL AND HORIZONTAL
GROUPS WITH CALLING LINE (FS2)

1.05 The marker tests lead VGT00-11 to determine which vertical groups have calls waiting for dial tone. It selects

one of these leads (VGT2 is always first choice) and then places battery on the correspondingly numbered VGA- lead to operate a VGA- relay, VGA- connects an HGT- lead from each line group in the vertical group to the marker via the line link marker connector. The marker can now identify the horizontal groups (within the vertical group selected) in which there are calling lines by testing for direct ground on the HGT- leads.

MARKER CONNECTS TO LINE LINK FRAME VIA
LINE LINK CONNECTOR

1.06 As soon as the marker is seized by the line link marker connector, it starts seeking a trunk link frame with an idle originating register and then selects this frame. As soon as it obtains the frame, it bids for the line link frame containing the calling line by operating the MF relay of the preference control and make-busy circuit through the line link marker connector. When it obtains the line link frame, MA1, MA2, MB1, and MB2 of the line link connector circuit operate. The marker is then connected to the line link frame by both the line link marker connector and the line link connector.

OPERATION OF VGB-, VGC-, HGA-, HGB-,
AND LG- RELAYS (FS1 AND 2)

1.07 When the line link connector MA1 relay operates, it connects leads HGO-9 and VGB00-11 to the marker. By this time the marker has either already selected or will shortly select the vertical and horizontal groups containing the calling line. As soon as it has selected these groups, it operates an HGA- and HGB- relay over an HGB- lead and a VGB- relay over a VGB- lead.

1.08 The VGB- relay operates from direct ground if the marker group is arranged for a maximum of 30 classes of service, or for class-of-service selection on a tens and units basis, or from ground in series with a CGA or CGB relay in the marker, if the marker group is arranged for a maximum of 60 classes of service. (See 1.22 and 1.23) Relay VGC-, when provided, operates in parallel with relay VGB-.

1.09 When the HGB0-9 relay operates and option ZR (percent load) is provided ground from the marker is extended over the PL- lead to the traffic register circuit, to score a register.

1.10 With the HGA-, HGB-, and VGB relays operated, a path is closed from the

line group relay LG- to the BS lead. However, the BS lead does not have battery connected to it by the marker until the marker receives ground on the HGK lead. The purpose of this is to insure closing the operating current of the LG- relay in the marker rather than on the HGA-, HGB-, or VGB- relay contacts so that protection can be provided on the basis of one per frame instead of one per LG- relay. The VGB- relay will operate before the closure of lead BS occurs.

1.11 The HG- resistance enables the marker to learn when an HGA- and HGB- relay operates falsely.

1.12 If the line link circuit is arranged for range extension, each horizontal group or groups equipped for range extension will operate an NLL or LOL relay in series with the line group LG- relay. Within a horizontal group equipped for range extension, line groups LG00-02, 06-11 can only work with long loop lines. Line groups LG03-05 can be cross-connected to work with either long or short loop lines. If any one of the line groups LG03-05 is cross-connected to work with short loop lines, all lines in that line group must be short loop lines. Ground extended to the marker through NLL or LOL relay contacts in the line link, indicates to the marker if it is working with a long or short loop line.

FINDING AN INDIVIDUAL LINE

1.13 When LG- operates, it connects the line hold magnet windings and the nonmultiplied front contacts of the L- relays of one line group into the marker. The hold magnets are on the LH- leads and the line relay contacts on the VFT- leads. The marker finds the calling line by testing for ground on the VFT- leads.

CHANNEL TESTS

1.14 While the marker has been hunting the calling line, it has been selecting an idle register and operating the link connector and junctor connector relays on the trunk link frame. With these relays operated, and with HGB- operated to connect the line links into the marker, the marker can make channel tests.

1.15 Each channel consists of a line link, a junctor, and a trunk link. If any one of these elements in a channel is busy (as evidenced by its being grounded), the whole channel is busy.

1.16 The marker furnishes battery through relay windings to the LB- leads which are connected to the line links by HGB- so that the marker can test that the lack of a busy ground on a link is not due to an open circuit.

1.17 As a result of channel tests, the marker selects an idle channel.

SETTING UP CHANNEL

1.18 When the marker has selected an idle channel, it places battery on the SM- lead with the same number as the selected channel to operate the L- and LJ- select magnets. The LJ- select magnet is on the combined switch. In general, two of these corresponding to opposite ends of the link, are connected in parallel. For example, select magnet 8 on switch 2 is in parallel with select magnet 2 on switch 8. (See FS103.)

1.19 With the select magnets on the line link frame and the trunk link frame operated, the marker operates the hold magnets. The line hold magnet L- is operated over an LH- lead, and the junctor hold magnet J- is operated from the trunk link frame over the junctor sleeve.

1.20 Leads LO- and L5- connect the sleeves of links 0 and 5 of each line switch horizontal group, to the traffic usage recorder. When a link is busy, ground on the sleeve is extended to this recorder circuit.

CLASS OF SERVICE - 30 CLASSES

1.21 After the marker found the line it completed a circuit through to the V- lead corresponding to the vertical file number of the calling line. Each V- lead is connected to a correspondingly numbered VU- or V- terminal by the VGB- relay. The terminals are cross-connected to the class-of-service terminal field to give a class-of-service indication to the marker over one of the 30 class-of-service leads CS0-29. All lines in one vertical file have the same class of service. The relation between a particular class of service and a CS lead number is established by cross-connections in the marker.

A. Class of Service - 60 Classes

1.22 If the marker group is arranged for a maximum of 60 classes of service, they are divided into 2 groups of 30 classes on each frame, group A and group B.

1.23 When the lines in a particular vertical group belong to the first group of 30 classes, the VGB relay is cross-connected to the CB terminal and operates in series with the CGB (class group B) relay in the marker.

B. Class of Service on a Tens and Units Basis

1.24 If the line link circuit is arranged for class-of-service selection on a tens and units basis, the V- leads from the marker are connected through diodes VTO-4 and VUO-4 and contacts on the VGB-relays to correspondingly numbered VT- and VU- terminals. The VT- terminals are cross-connected to CSO-9 terminals and the VU- terminals are cross-connected to CS10-19 terminals to give the class of service indication to the marker over two leads. The CSO-9 leads give the tens digit of the class of service and the CS10-19 leads give the units digit. All lines in a vertical file must have the same class of service. Cross-connections in the marker establish the relationship between the two CS- leads grounded and the corresponding class of service. When the marker finds the line, it closes a circuit through the V- lead corresponding to the vertical file number of the calling line. This extends through the diodes, VGB- relay contacts and cross-connections to operate two class relays in the marker.

C. Rate Treatment

1.25 If the line link circuit is arranged for rate treatment (option G), the V- leads from the monitor are multiplexed to diodes VRO-4 and VRGO-4 in addition to diodes VTO-4 and VUO-4 (Fig. 14) or diodes VO-4 (Fig. 16). These diodes connect ground from the marker through contacts on the VGB- relays to cross-connection terminals VRO-4 and VRGO-4. Terminals VRO-4 are cross-connected to class-of-service terminals CS20-29 and terminals VRGO-4 are cross-connected to class-of-service terminals CA and CB to give 20 possible rate treatments. The CS20-29 leads give the units digit of the rate treatment number and the CA and CB leads give the tens digit. Cross-connections in the marker determine the significance of the rate treatment and its relation to class of service.

1.26 With rate treatment the class of service can be used to segregate PBXs where the PBX lines are switched directly by the No. 5 crossbar office of which this circuit is a part. The rate treatment may then indicate that the line is a PBX line of a certain type and the class of service would indicate to which PBX the line belongs.

1.27 Non-PBX lines in the same office are marked by a different combination of class of service and rate treatment. Certain classes of service may be reserved for lines that require specific marker operations with the rate treatment used to indicate dialing privileges or charging rate for this class of line. In this case, such a class of service cannot be used to indicate the PBX to which a line belongs even when a different rate treatment is used.

D. Addition of a Basic Frame Arranged for Class-of-Service Selection on a Tens and Units Basis, to Offices Arranged for a Maximum of 30 or 60 Classes of Service (Options F and H and App Fig. 14)

1.28 Basic line link frames of Issue 10D or later are provided with diodes and VGB- relays that permit class-of-service selection on a tens and units basis. These frames are used in addition to offices arranged for a maximum of 30 or 60 classes of service. With this arrangement, only the VU (0-4) terminal punchings are used in cross-connecting to the CS punchings and any VU- punching may be cross-connected to any one of the CSO to CS29 class-of-service punchings. Since the line insulation test circuit in offices arranged for a maximum of 30 or 60 classes of service requires current to flow in the direction opposite to that permitted by the diodes, the diodes are bypassed (option F) for frames added to such offices.

E. Addition of a Supplementary Frame Arranged for Class of Service Selection on a Tens and Units Basis, to a Basic Frame Arranged for a Maximum of 30 or 60 Classes of Service (Options F and H)

1.29 Supplementary line link frames of Issue 10D or later are provided with VGB- relays that permit class-of-service selection on a tens and units basis. These frames are used to build out the frame capacity of basic frames arranged for a maximum of 30 or 60 classes of service. With this arrangement, only the VUO-4 leads are cabled back to the basic frame where they are cross-connected to the CSO-29 leads. The basic frame does not require diodes where the line link frames are arranged for a maximum of 30 or 60 classes of service.

F. Class of Service - 20 Classes (AMN)

1.30 Basic line link frames arranged for a maximum of 30 or 60 classes of service without options F, H, and App Fig.

14 can be modified to a maximum of 20 classes of service with the addition of diodes VU-4 (Fig. 16 and App and Wrg) and option B. Terminals VU-4 are cross-connected to terminals CS00-19. Ground terminal is cross-connected to terminals VU00-11. In addition rate treatment is also added (according to 1.25 through 1.27). Basic link frames added or an existing basic link frame of Issue 100 or later in an office rearranged from a maximum of 30 or 60 classes of service to a maximum of 20 classes can be adapted for centrex if options Fig. 14, H, and G are provided. Option F wiring, which bypasses diodes VU-4, is removed on existing basic frames. The line insulation test circuit must also be rearranged for centrex use when the F wiring is removed. Cross-connections are made from the VU-4 terminals to the CS00-19 terminals, and the VU-4 terminals are not used.

1.31 New supplementary line link frames added to an office rearranged to a maximum of 20 classes of service require only the VU-4 leads to be cabled back to the new or modified basic frames where they are cross-connected to the CS00-19 terminal.

G. Class of Service on a Hold Magnet Basis (App Fig. 17)

1.32 When App Fig. 17 is provided, class of service may be on a hold magnet basis within the vertical file associated with the VF- relay. The VP- relay is cross-connected to the terminal of the vertical file selected and operates over this cross-connection to the marker. The contacts of the operated VF- relay and the operated HG- relays place a ground on one of the HMC- and HMR- terminals. These terminals will replace any two of the VU-, VT- or VR- terminals for that vertical file. See Note 409 for complete cross-connection detail.

H. Class of Service - Originating Test Line for Office Test Frame - App Fig. 19 ("Mr Disc.")

1.33 When App Fig. 19 is provided, the class-of-service lead for vertical file 2 vertical group 2 will be extended through the auxiliary relay and the office test frame. Thus the class of service for the originating test line will be determined by the setting of the CS switch in the office test frame.

RELEASE OF LINE LINK FRAME

1.34 After the hold magnets are operated to set up the call, the marker makes various continuity tests, establishes the connection from the subscriber to the register, and then dismisses the line link frame. To do this it removes battery from leads HG- and BS and from the line link connector at about the same time. However, the battery on the VGB- leads to the VGB-relays is not removed until MAI releases in order that the transient from the winding of LG- through the HGA- or HGB- and VGB- contacts into the capacitor LG- will be over before the contacts open. The HGA- and HGB- relay is sufficiently slow in releasing that it does not open this transient.

RELEASE OF CONNECTOR

1.35 When the marker is ready to release the connection between itself and the line link frame it opens the circuit to the OC1 or OC2 leads over which the MS relay of the marker connector preference control circuit is held operated. The multicontact relays of the line link marker connector release.

1.36 Relay TC or TC1 in the connector control circuit FS4 which were operated by OC in the marker may or may not release at this time. If no other connectors in the group are being served by a marker, TC or TC1 will release. If other connectors in the group are being served, the marker connector frame control relays FC and FC1 will be operated and will hold TC or TC1. The TC or TC1 and relays in the master traffic control circuit jointly hold the FC or FC1 relays. The connector is then gated and the line link frame will not be able to obtain a marker for an originating call until all of the other ungated connectors waiting to be served have been served.

2. CONNECTION BETWEEN CALLING LINE AND INTRAOFFICE, OUTGOING, INTERMARKER GROUP, OR REVERTING CALL TRUNK (CALL BACK SC3)

MARKER CONNECTS TO LINE LINK FRAME AND OPERATES HGA-, HGB-, VGB-, VGC-, AND LG- RELAYS

2.01 The marker obtains access to the line link frame through the preference control and make-busy circuit and line link

connector circuit. The marker will have battery on the HG- lead corresponding to the horizontal group number which it obtained from the register and on the VGB- lead corresponding to the vertical group number. The marker also receives an indication from the register indicating whether the line link is working with a long or short loop line. This allows the marker to signal the range extension circuit if needed. Therefore, when MAI relay operates, and HGA-, HGB-, VGB-, and VGC- (option G) relay will operate. The operation of the LG- relay then takes place as described in 1.07 through 1.12.

CHANNEL TESTS

2.02 While the marker is performing the above functions, it is operating the link connector and junction connector relays on the trunk link frame of which it had possession at the time it bid for the line link frame. With these relays operated and with the HGA- and HGB- relays of the line link frame operated, the marker can make channel tests as described in 1.14 through 1.17. It should be noted that the marker considers as idle the link in the channel used for the dial tone connection on the basis of information received from the register. After an idle channel has been selected, the marker operates the L- and LJ- select magnets as described in 1.18 through 1.20.

RELEASE OF CONNECTION BETWEEN CALLING SUBSCRIBER AND REGISTER

2.03 Before the channel can be set up to a trunk, the connection to the register must be released. Ground is removed from the sleeve in the register to drop this connection. When the L hold magnet releases, the line relay is reconnected to the line and will reoperate. This reoperation of L must not be allowed to cause false seizure of a marker through the line link marker connector.

LOCKOUT ON SUBSCRIBER TO REGISTER CONNECTIONS (FS5)

2.04 The conditions governing the arrangement used to prevent the false seizure of a marker when the subscriber to register connection is released are:

- (a) If the line link marker connector associated with the line link frame under consideration is already in use because of an originating call, the start leads must not be opened as this might release the marker. Reoperation of L will not seize a marker since the marker is already connected.

- (b) If the line link marker connector associated with the line link frame under consideration is not in use, the start leads must be opened while the L relay is reoperated after the subscriber-register connection is released.

2.05 When a marker making a line-to-register connection obtains access to this frame through the frame connector in addition to its original access through the marker connector, it applies ground to lead G of the frame connector which, with relay DT operated, goes over lead DTK of the marker connector to operate the DTK relay in the marker which checks this path. This check is made to insure that the path will be available for the functions described below.

2.06 When a marker seizes this frame for an originating line-to-trunk connection after a line-to-register connection has been started, ground applied to lead G returns over lead DTK through the line link connector to the marker making the line-to-trunk connection (relay DT being operated). This prevents LOT1 in the marker from operating and in turn battery will be withheld from the LOB lead preventing LO from operating. Condition (a) is thus met. This same ground over lead DTK of the marker connector informs the marker making the line-to-register connection that the momentary operation of and L- and VGB- relay should be disregarded as it is probably due to the release of the line-to-register connection.

2.07 When a marker seizes this frame for a line-to-trunk connection with no line-to-register connection in progress, ground applied to lead G comes back to the marker on lead LO. The marker then applies battery to lead LOB to operate relay LO which opens the start leads thus meeting condition (b).

SETTING UP CHANNEL

2.08 The channel selection was described in 2.02. The channel is now set up by the operation of the hold magnets. The line hold magnet is operated over the LH lead of the same number as the vertical file number furnished to the marker by the register.

RELEASE OF LINE LINK FRAME

2.09 The marker makes various continuity tests after operating the hold magnets and then releases the line link frame as described in 1.34.

PAIRED LINE LINK FRAME OPERATION

2.10 Where the office is arranged for paired line link frame operation an even frame and an odd frame may be paired as mate frames. Through the use of an auxiliary line link frame associated with two mate frames the marker will be able to select junctors of a mate frame for use when all junctors of the original line link frame are busy.

2.11 When the MCA relay is operated a resistance ground will be extended over the LFK lead to indicate to the marker that it is working with a paired line link frame. If the marker finds all channels busy it will junctor step and operate relay MPP in Fig. 28 of the mate line link frame preference control circuit. When the MPP relay has the work preference, indicating the mate frame is locked out to all other markers, it will extend a ground on an LV lead, through the operated HGB-9 relay to the auxiliary line link frame for operation of an LV- and an EV or ODD relay. At this time the marker checks for operation of only one LV- relay over the HGK lock. (If the XHG relay in the marker operates it indicates two or more LV-1 relays have operated.) Operation of the EV or ODD relay will indicate to the marker that the mate line link frame is locked out and that select magnet cut-in relays are operated.

2.12 The marker will now test for an idle channel and if available will establish a connection via the auxiliary line link frame between the customer and the selected trunk.

3. CONNECTION BETWEEN CALLED SUBSCRIBER AND INTRAOFFICE, INTERMARKER GROUP OR INCOMING TRUNK (CALL FORWARD SD2) TERMINATING CALL SC3

MARKER CONNECTS TO LINE LINK FRAME AND OPERATES HGA-, HGB-, VGB-, VGC-, AND LG--RELAYS

3.01 The marker obtains access to the line link frame through the preference control and make-busy circuit and line link connector circuit. The marker has battery on the VGB- lead corresponding to the vertical group and on the HG- lead corresponding to the horizontal group at the time the connector relay is operated. Therefore, an HGA-, HGB-, and VGC- (option G) relay will immediately operate. The operation of the LG- relay then takes place as described in 1.07 through 1.12.

3.02 Relay LG- gives access to the line sleeve through the LH- lead of the same number as the vertical file furnished

by the number group. If the sleeve is found busy, the marker releases the line link frame as described in 1.34 and causes the busy signal to be returned.

CHANNEL TEST

3.03 While the marker is getting the hold magnet location from the number group, it is also working in the trunk frame to operate the link connector and junctor connector relays. The junctor connector relay cannot be operated until after the line link frame number has been obtained from the number group.

3.04 With HGA- and HGB- operated to connect to the line links and with the link and junctor connector relays on the trunk link frame operated, the marker can make channel tests as described in 1.14 through 1.17.

SETTING UP CHANNEL

3.05 After an idle channel has been selected, the marker operates the L- and LJ- select magnets as described in 1.18 through 1.20 and then operates hold magnets to set up the channel. The line hold magnet is operated over the LH- lead of the same number as the vertical file number obtained from the number group. The junctor hold magnet is operated from the trunk link frame over the junctor sleeve.

RELEASE OF LINE LINK FRAME

3.06 The marker makes various continuity tests after operating the hold magnets and then releases the line link frame as described in 1.34.

NO-TEST CALL

3.07 If a no-test call is made to an idle line, the operation is the same as on a regular call.

3.08 If the line is busy, the operation is the same as on a regular call up to the point of line-busy test. At this time, the marker places positive battery on the line sleeve. This battery will be detected by the marker on the LL- lead corresponding to the link which is connected to the line in question. The marker operates the corresponding L- and LJ- select magnets. The marker also places ground on the NT lead which is connected to the no-test connector circuit through contacts on the HGA- relay. In the no-test connector this ground operates a hold magnet associated with the no-test trunk. With the no-test connector hold magnet operated, the ground is connected to the no-test hold magnets on the

line link frame. Five of these (those associated with horizontal groups 0 to 4 or 5 to 9) operate but only the crosspoints on the switch on which the select magnets are operated will be closed. Thus a connection is established between the line and the no-test trunk.

PAIRED LINE LINK FRAME OPERATION

3.09 See 2.10 through 2.12.

4. LINE INSULATION TESTING

4.01 The line insulation test control circuit is placed in series with the connection to a nonspecial marker. It seizes a line link frame and connects through the line link connector just as a marker would. It connects through to the particular line by the no-test connector circuit operating the five hold magnets for the five horizontal groups within which the line is located; using an idle link in the particular horizontal group but not operating any junctor hold magnet.

A. Apparatus Fig. 17 Application With Tie Line Pad Control or Line Link Pulsing (FS11)

4.02 When tie line pad control or line link pulsing is provided, App Fig. 17 must be provided on all line links that require that feature. The VF- relay (App Fig. 17) will close a path to perform the following functions:

In phase I and	Operate a relay in
II Centrex:	the associated trunk
	to cut in a 2 dB pad.
In line link	Operate an F relay
pulsing:	in the line circuit.

5. LINE LOAD CONTROL FEATURES

OPERATION OF LINE LOAD CONTROL RELAY (FS3)

5.01 The lines of each line link frame are divided into three classes A, B, and C by vertical groups. Any vertical group may be designated as class A. Lines in class A are not denied originating service. Lines in class B are in the even-numbered vertical groups and those in class C are in the odd-numbered vertical groups. The lines in either or both of these classes may be denied originating service.

5.02 Relays B and C for classes B and C, respectively are controlled from a central point by means of the line load control circuit and in turn open the operating circuits of their associated even and odd vertical group start VGS-relays. However, the break contacts of relays B or C associated with vertical groups designated as class A are short-circuited by cross-connecting terminals G- to VG- and these lines are, therefore, not denied service.

5.03 The B relay operated over lead B (a) grounds lead AB to the line load control circuit to provide a locking path for the B relay of the line load control circuit independent of the master class key and (b) grounds lead LB to the line load control circuit to light a lamp thus indicating that the B relay of the line link frame has operated. When it is desired to release relay B the frame key in the line load control circuit is operated.

5.04 The C relay operates over lead C and controls leads AC and LC in the same manner as described above for the B relay.

OPERATION OF CALLS WAITING TIMING CIRCUIT

5.05 When relay DT operates indicating that a call has been originated, relay CWT is connected to the cathode, terminal 4, of tube CWT, and the discharge circuit for capacitor CW1 is opened. Capacitor CW1 will now start to charge from +130 volts through resistance CW1. The charging rate is controlled by resistance CW1 and is such that the potential at terminal 1 of the tube will not reach the tube ionizing potential until approximately 5 to 8 seconds have elapsed. At this time the tube ionizes between terminals 1 and 4 and immediately transfers and sustains across the tube main gap (between terminals 2 and 4) operating relay CWT. Relay CWT operated connects ground to lead G to the line load control circuit lighting an associated lamp. This lamp remains lighted as long as relay DT remains operated indicating originating calls are waiting to be served.

5.06 When relay DT releases, indicating no originating calls are waiting to be served the circuit from the cathode of tube CWT through relay CWT is opened

releasing relay CWT and deionizing tube CWT. Also the discharge circuit for capacitor CW1 is closed through resistance CW2. The release of relay CWT removes ground from lead G to the line load control circuit extinguishing the associated lamp.

6. MARKER CONNECTOR CONTROL CIRCUIT

TIMING CIRCUIT (FS6) TM TUBE AND CA RELAY

6.01 An overall timing circuit is provided which sounds the major alarm if a line link calling for a marker has not been connected to one within 5 to 10 seconds. It functions as follows: Upon the start of a call the line link connects ground to the TM relay at the same time that battery is connected to the start leads for marker seizure. The TM and TML relays operate. The TML relay operated removes the short around the A capacitor. The capacitor starts to charge from negative 48-volt battery through the CA relay winding to positive 130 volts through resistance A. Resistance A is so chosen as to provide a 5-second interval before charging the capacitor to approximately 70 volts at which point the TM tube ionizes due to breakdown between its control gap terminals 5 and 7. When broken down, sufficient current is caused to flow between the main gap terminals 2 and 7 to operate the CA relay which locks under control of the master test frame jack, lamp, and key circuit and sounds the major alarm.

6.02 For normal operation a marker is seized before the 5-second interval has elapsed. This is indicated by the operation of the MK relay FS4 from the operated marker multicontact connector relays in line link marker connector circuit. The MK relay releases the TM and TML relays. During the releasing time of TM and TML relays the TM tube timer circuit is recycled by discharging the A capacitor through the C resistance. The TML relay normal with the MK relay operated restarts the A capacitor charging circuit to time the release by the marker. If the marker releases the connector within 5 seconds or less the TM tube will not break down. However, should the marker exceed this time because of some trouble condition or should the marker connector relays remain operated due to a trouble the TM tube will fire as described before, operating the CA relay to operate the major alarm.

6.03 The MK relay releases at the end of the call upon release of the line link marker connector circuit multicontact relays and discharges the A capacitor to recycle the TM timer for the next call.

ALTERNATE MARKER PREFERENCE (FS4)

6.04 The W and Z relays provide means for advancing marker preference by controlling the closure of the marker start leads. For the first call the W relay operates while the marker is connected and the Z operates when the marker releases. On the next call, the W relay is shunted but the Z is held while the call is connected to the marker. The Z releases when the marker is released. The Z relay, in operating or releasing, shifts the start lead preference. The Z and W relays in combination hold operated the TC or TCI to prevent a false start on the start lead used on the previous call.

TROUBLE RELEASE (FS4)

6.05 When the marker finds it necessary to disconnect because of some trouble, it connects ground to the TRL lead to operate the TRL relay which operates the TR relay. The TR relay locks independent of the TRL relay, opens the marker start leads and releases the operated MS relay in the preference control circuit, in turn releasing the multicontact line link marker connector relays. Release of the multicontact relays releases relay MK allowing the Z relay to operate or to release.

6.06 The release of the LLMC multicontact relays removes ground from the TRL lead thus releasing the TRL relay which recloses the marker start leads and removes the shunt from the TRL relay. Relay TRL operates, and indicates to the second marker by ground on the TR2 lead that the call is a second trial. The MK relay, in operating upon seizure of the second marker, connects ground through the front contacts of the MK and TRL relays and the back contacts of the TRL relay to the lower end of the winding of the TR relay thus shunting it down. The TRL relay is still held operated from ground on the back contacts of the TR relay and the front contacts of the TRL and MK relays. If the second marker completes the call satisfactorily, release of the MK relay will release the TRL relay and the next call will be handled as a first trial, as indicated by ground on the TRK lead.

6.07 Should the second marker on second trial also encounter trouble it will connect ground to the TRL lead and again operate TRL. The TRL relay removes the shunt on the TR relay which operates and opens the marker start leads to release the connector. Relay TRL release causes the start circuit to advance to the next marker. The MK relay operating upon seizure of the next marker, shunts

down the TR relay. The TRL relay remains operated. If the call is completed satisfactorily, the TRL relay will release when the MK relay releases. Should the marker continue to encounter trouble it will again ground the TRL lead and recycle the marker connector in the same manner as described.

6.08 Since a failure of the TRL relay to release, due to a trouble ground prevents seizure of a marker and thus holds the connector out of service, a circuit is provided to hold the MK relay operated in order to function the TM timer and operate the major alarm should these relays remain operated for an abnormal period of time.

TRANSFER OF MARKER START LEADS

6.09 On failure of a marker connector to obtain a marker within approximately one second, providing there is a marker available, a timing circuit functions in FS6 to transfer the start lead preference from A to B or from B to A.

6.10 A call in originating operates the TM and TML relays, FS5. The TM relay connects the IM relay FS4 to the IM lead of the master traffic control circuit. This circuit recognizes the fact that there is a call waiting by closure of grounds to the TCA, TCB, and CWA or CWB leads and operates its IM relay if there is an idle marker. This grounds the IM lead and operates the IM relay in FS4. The IM relay starts the TRS tube timer. If a marker is not seized in approximately one second, providing markers are available as indicated by the maintenance of ground on the IM lead the TRS tube will fire and operate the TRS relay. The TRS relay opens the start lead in use and closes the alternate one, releases the TM relay and holds the TML relay operated. The TM relay is released to open the signal leads to the traffic control circuit to prevent its timing out because of a marker connector trouble. The TM relay also releases the IM relay to recycle the timer. The TML relay is held operated to continue the blanket timing

before a marker is seized. The TRS relay locks operated through the TML relay. When a marker is obtained over the new start lead, the TML relay releases upon operation of the MK relay. The TRS relay remains operated over its locking contacts under control of the MK relay. The TRS relay transmits to the marker the fact that the transfer has taken place. This information is passed over the TRS lead. Upon release of the marker, the MK relay, in releasing, will release the TRS relay.

7. JACKS AND CORDS

TRAFFIC USAGE RECORDING JACK AND CORD (FS8)

7.01 To record the number of times a subscribers line is found busy for traffic usage recording, the WIAM cord is plugged into one of the SIO-9 jacks and the 351F plug is connected to the desired subscriber line on the line switch frame.

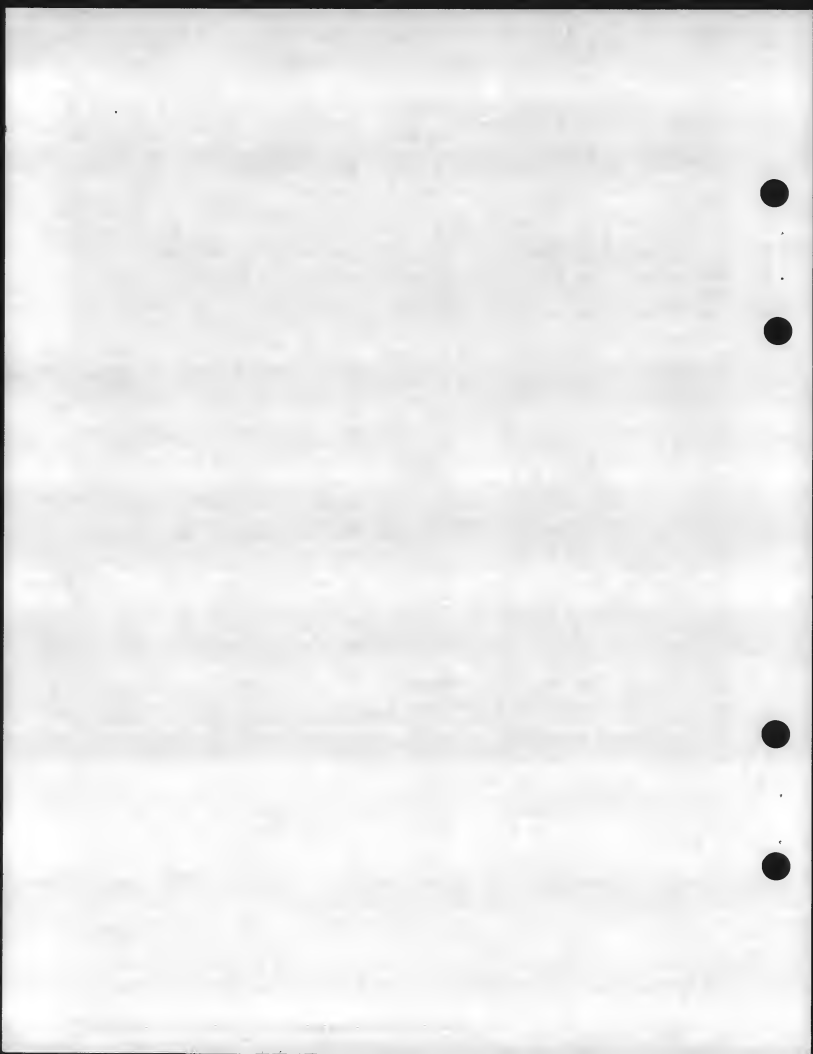
SERVICE OBSERVING JACK AND CORD (FS9)

7.02 To observe on a subscriber line the 324A plug is inserted into dual jack SO and the 351A plug is connected to the desired subscriber line on the line switch frame.

TEST LINE JACK (FS9)

7.03 Jacks TL are used for extending a subscriber line to a test line jack in the patching jack circuit for connection to the call through test set or to the intermittent trouble test trunk.

7.04 When the patching jack circuit is not provided in the office, the sleeve lead of the "B" TL jack connects to the MDF to facilitate cross-connection to the test trunk circuit. The cord used for connecting from the TK jack to the subscriber line is provided on the patching jack circuit or by the service observing cord of FS9.



SECTION III - REFERENCE DATA1. WORKING LIMITS

- 1.01 For L relays, see range chart in keysheet.
- 1.02 Not more than eight select magnets shall be operated in multiple.

2. FUNCTIONAL DESIGNATIONS2.01 Relays

<u>Design</u>	<u>Meaning</u>
B	Class B Line Load Control
C	Class C Line Load Control
CA	Connector Alarm
*CWT	Calls Waiting Timing
DT	Dial Tone
HGA-	Horizontal Group
HGB-	Horizontal Group
IM	Idle Marker
LO-4	Line
LG-	Line Group Connector
LO	Lockout
LOL	Long Loop
MK	Marker Seizure Check
NLL	Nonlong Loop
TC	Traffic Control (STA START)
TC1	Traffic Control (STB START)
*TM	Timing
TM1	Timing
TR	Trouble Release
TR1	Trouble Release
TRL	Trouble Release
*TRS	Transfer Start Lead
VFA,B,C	Vertical File
VGA-	Vertical Group

Relays

VGB-, VGC-	Vertical Group
VGS	Vertical Group Start
W	Marker Start Lead Steering
Z	Marker Start Lead Steering

2.02 Switches

<u>Design</u>	<u>Meaning</u>
L	Line Switch
LJ	Combined Line and Junctor Switch

2.03 Switch Magnets

<u>Design</u>	<u>Meaning</u>
J (HOLD)	Junctor Hold Magnet
L (HOLD)	Line Hold Magnet
L (SEL)	Line Select Magnet
LJ (SEL)	Combined Line and Junctor Select Magnets
NT (HOLD)	No Test Hold Magnet

*Relay and Tube

3. FUNCTIONS

- 3.01 To operate a line relay when the subscriber loop is closed.
- 3.02 To provide means of operating the line link marker connector.
- 3.03 To provide means by which the marker can determine the vertical and horizontal groups in which a calling line is located.
- 3.04 To provide means by which the marker can determine the location of the hold magnet of a calling line.
- 3.05 To provide means by which the marker can connect to the links.
- 3.06 To provide means by which the marker can connect battery to the links.
- 3.07 To provide the marker with access to the line and junctor switch select magnets.

- 3.08 To provide the marker with access to the line hold magnets (or line sleeves).
- 3.09 To provide the marker with the class of service of a line.
- 3.10 To prevent the false seizure of a marker through a line link marker connector due to momentary operation of a line relay during a callback call.
- 3.11 To provide means by which the marker can determine when an HGA- or HGB-relay is operated falsely.
- 3.12 To provide means of connecting a busy line to a no-test connector circuit.
- 3.13 To provide means of making the frame busy to all markers except those doing a dial tone job.
- 3.14 To provide means of making a junctor switch busy.
- 3.15 To provide means of operating a traffic register associated with a particular horizontal group when the marker finds more than a predetermined number of links busy in that horizontal group.
- 3.16 To provide means for use in conjunction with the line load control circuit to deny originating service to lines in class B and class C.
- 3.17 To provide means for use in conjunction with the line load control circuit to give a lamp indication of an overload condition in a line link frame.
- 3.18 To prefer the use of different markers on successive calls through the marker connector. The start lead preference is shifted on successive calls through a W and Z relay combination.
- 3.19 To provide a marker connector control circuit whose functions are:
- 3.20 To advance preference for markers by alternating between two start lead circuits on successive calls.
- 3.21 To signal the traffic control circuit that a call is originated and to remove this signal when the call is connected to a marker.
- 3.22 To start an overall timing circuit functioning upon the start of a call and to sound a major alarm at the end of a specified interval if the call is not satisfied. The alarm locks in under control of a key at the maintenance center.
- 3.23 To start a short timing circuit functioning, the purpose of which is to switch the marker connector preference of a marker to the alternate start lead if the call has not been connected to available markers within a specified interval. The timing is canceled if all markers are busy. Indication of the shift is transmitted to the markers for recording purposes.
- 3.24 To recycle the overall timing circuit after a marker is seized and start retiming for a disconnect by the marker.
- 3.25 To recycle the overall timing circuit between calls.
- 3.26 To provide means for recording a second trial signal from a marker releasing that marker and steering the call into another idle marker.
- 3.27 To provide means of connecting links 0 and 5 of every line switch horizontal group, to the traffic usage recorder, for traffic measuring.
- 3.28 To provide jacks and cords for setting up service observing connections.
- 3.29 To provide a test line to the patching jack circuit for connecting a subscriber line to the call through test set or to the intermittent trouble test trunk, or to provide a direct connection of the sleeve lead to signal the test trunk circuit via the MDF of a line hold magnet operation.
- 3.30 To provide jacks and cords for setting up connections for traffic usage recording at the subscriber lines.
- 3.31 To provide for extending an IU ground from the preference control circuit for the mate line link frame according to horizontal group to the auxiliary line link circuit.

4. CONNECTING CIRCUITS

- 4.01 When this circuit is listed on a keysheet the information thereon is to be followed.
- 4.02 Subscriber Line.
- 4.03 Master Test Control Circuit - SD-25800-01.
- 4.04 Trunk Circuits - SD-25696-01 (Typical).
- 4.05 Auxiliary Line Circuits.
- 4.06 Number Group Circuit - SD-25556-01 or SD-26034-01.

- 4.07 Subscriber Message Register Circuit - SD 25770-01.
- 4.08 No-Test Connector Circuit - SD-25702-01.
- 4.09 Line Link Marker Connector Circuit - SD-25586-01 or SD-26022-01.
- 4.10 Traffic Register Circuit - SD-25892-01.
- 4.11 Preference Control and Make Busy Circuit - SD-26039-01.
- 4.12 Master Test Frame, Jack, Lamp, and Key Circuit - SD-25762-01.
- 4.13 Trunk Test Circuit - SD-25818-01.
- 4.14 Alarm Circuit - SD-25671-01.
- 4.15 Trunk Link and Connector Circuit - SD-25549-01 or Trunk Link Circuit - SD-26032-01.
- 4.16 Incoming Trunk Test Line Circuit - SD-25771-01.
- 4.17 Trunk Make Busy Circuit - SD-25688-01.
- 4.18 Line Load Control Circuit - SD-96387-01.
- 4.19 Line Link Connector Circuit - SD-26031-01 or Line, Line Link and Connector Circuit - SD-25548-01.
- 4.20 Marker Connector Preference Control Circuit - SD-26029-01.
- 4.21 Master Traffic and Frame Control Circuit - SD-26020-01.
- 4.22 Patching Jack Circuit - SD-96068-01.
- 4.23 Observing Line Circuit - SD-25860-01.
- 4.24 Traffic Usage Recorder Circuit - SD-95738-01.
- 4.25 Test Trunk Circuit - SD-26113-01.
- 4.26 Attendant Trunk Circuit - SD-27582-01.
Line Concentrator Control Circuit - SD-96536-01 (Typical).
- 4.27 Dial Long Line Circuit - SD-96588-01 (Typical).

- 4.28 Office Test Frame - SD-27633-01.
- 4.29 Auxiliary Line Link Circuit - SD-27633-01.
- 4.30 Range Extension Circuit - SD-27806-01.
- 4.31 Line and Switch Circuit - SD-99334-01.
- 4.32 Attendant Auxiliary Line Circuit - SD-27862-01.
- 4.33 Position and Position Loop Circuit - SD-27695-01.
- 4.34 Conference Control Circuit - SD-27591-01.
- 4.35 2-Way CO Trunk Circuit - SD-99346-01.
- 4.36 Automatic Intercept Line Circuit - SD-27729-01 and SD-27730-01.

5. TAKING EQUIPMENT OUT OF SERVICE

GENERAL

5.01 Any lines on which service cannot be interrupted while a circuit or piece of apparatus is out of service may be given emergency treatment in accordance with approved practices.

LINE LINK FRAME

5.02 The link frame may be taken out of service by inserting a No. 349A plug into the LMB jack of the line link frame. This will bring in a major alarm and will make the line link frame and line link connector frame busy to the marker on all except originating calls.

5.03 Blocking operated the LO relay will take the line link frame out of service to all originating traffic.

LINE SWITCH

5.04 A line switch cannot be removed from service without denying service to as many as 20 subscribers. Therefore, any trouble which affects an entire line switch should be cleared immediately.

L- HOLD MAGNET

5.05 The hold magnet should be normal before making the line busy. The

line is made busy by inserting a No. 351C plug into the sleeve grounding jack associated with it. Any trouble on hold magnets associated with line circuits should be cleared immediately.

Caution: It is important that no crosspoints be closed by the line hold magnet. Therefore, the No. 351C plug should not be inserted into the jack while a select magnet is operated.

NT HOLD MAGNET

5.06 The NT hold magnet cannot be removed from service without removing from service the 4 NT magnets connected in parallel with it on one half of the line link frame. Therefore, any trouble on this hold magnet should be cleared immediately.

L- AND LJ- SELECT MAGNET

5.07 To take out of service a select magnet on a line switch, make busy the associated line link. To take out of service a line junctor select magnet (except on one line junctor select magnet of a horizontal group) take out of service the line junctor select magnet in parallel with it by making busy both links associated with those magnets.

LINE LINK

5.08 To make busy a line link insert a No. 349A plug into the JS- jack of the junctor switch associated with the link to be taken out of service. Await the release of any junctor hold magnets which were operated. Connect ground to the line link to be made busy either at the HGB- relay terminal on which the line link appears or at the line switch horizontal. Remove the make-busy plugs from the JS- jack.

JUNCTOR SWITCH

5.09 Take a junctor switch out of service by making the switch busy. To do this insert a No. 349A plug into the correspondingly numbered JS- jack on the line link frame.

J- HOLD MAGNETS (JUNCTORS)

5.10 Take out of service the junctor switch on which the hold magnet is mounted by inserting a No. 349A plug into the correspondingly numbered JS- jack on the line link frame. Await the release of the J- hold magnet if it was operated. Then make busy the associated junctor by inserting the No. 351C plug into the sleeve grounding jack of the J- hold magnet. Remove the make-busy plug from the JS- jack.

RELAYS

5.11 DT Relay: To take this relay out of service block it operated. Doing this may give to a marker trying to make a line to trunk connection an indication that a call is being originated on the frame, when one is not actually being originated.

5.12 HGA- and HGB- Relays: None of these relays can be removed from service without seriously affecting service to as many as 59 subscribers located in that horizontal group. For this reason clear any trouble on these relays immediately.

5.13 L- Relays: To take one of these Relays out of service block it nonoperated. Blocking this relay nonoperated will prevent that subscriber from originating a call. Where the line is associated with an emergency line circuit, arrange with the distant DSA operator to have the emergency line group, of which the line being taken out of service is a part, transferred.

5.14 LG- Relays: None of these relays can be removed from service without denying service to 5 lines. For this reason clear any trouble on these relays immediately.

5.15 LO Relay: To take this relay out of service block it nonoperated. With this relay blocked nonoperated at a time when a marker is attempting to complete a line to trunk connection through the line link frame associated with the particular LO relay, the relay cannot open the start leads. Another marker may, therefore, start due to momentary reoperation of the L relay of the line being connected to the trunk.

5.16 VGA- Relays: None of these relays can be removed from service without denying originating service to as many as 50 subscribers in a vertical group. For this reason clear any trouble on these relays immediately.

5.17 VGB- Relays: None of these relays can be removed from service without denying both originating and terminating service to as many as 50 subscribers in a vertical group. For this reason clear any trouble on these relays immediately.

5.18 VGC- Relays: None of these relays can be removed from service without denying originating service to as many as 50 subscribers in a vertical group. For this reason clear any trouble on these relays immediately.

- 5.19 VGS- Relays: None of these relays can be removed from service without denying originating service to as many as 50 subscribers in a vertical group. For this reason clear any trouble on these relays immediately.
- 5.20 CA, IM, MK, TC, TCl, TM, TmI, TR, TRl, TRl, TRS, W, and Z Relays: These relays may be removed from service by blocking them nonoperated. However, the following irregularities will result:
- 5.21 CA Relay: Blocking this relay non-operated prevents sounding the major alarm when the connector times out, waiting for connection to a marker or the release of a marker.
- 5.22 IM and TRS Relays: Blocking either of these relays nonoperated prevents the transfer of start leads on failure to obtain a marker within approximately 1 to 3 seconds.
- 5.23 MK Relay: Blocking this relay non-operated prevents recycling the TM timing when the marker is connected.
- 5.24 TC and TCl Relays: Blocking these relays nonoperated prevents full operation of the traffic control feature and some one marker connector may, therefore, be delayed unduly in seizing a marker.
- 5.25 TM Relay: Blocking the TM relay nonoperated prevents full operation of the traffic control feature and prevents the TM timing from seizing a marker.
- 5.26 TmI Relay: Blocking the TmI relay nonoperated prevents the TRS and TM timing from seizing a marker.
- 5.27 TR Relay: Blocking the TR relay nonoperated prevents the release of the marker and marker connector on trouble release until the marker times out.
- 5.28 TRl Relay: Blocking the TRl relay nonoperated prevents giving the marker a second trial indication.
- 5.29 TRl Relay: Blocking the TRl relay nonoperated prevents the release of the marker and marker connector on trouble release until the marker times out.
- 5.30 W and Z Control Relays: Block W nonoperated to remove either from service. This will prevent changing marker preference on alternate calls.

6. DESCRIPTION OF ALARMS

- 6.01 If markers are available and the TC and TCl relays are released and the call is not served in approximately one second, it will be transferred to the next marker in the preference chain. When a transfer is made a transfer indication is given by the marker connector to the marker which in turn will cause a trouble record to be made, the minor alarm to sound, and the white aisle pilot and main aisle pilots to light.
- 6.02 If a call is not served by a marker connector in approximately 7.5 seconds, a major alarm will sound.
- 6.03 If a marker is held by a marker connector for approximately 7.5 seconds the marker connector will sound the major alarm. Under this condition the marker timing circuit will function, causing the marker to give a trouble release to the marker connector on a first trial basis and leaving a trouble record indicating a first trial failure.
- 6.04 All the keys and lamps associated with the master traffic control circuit, the time alarm circuits for the marker connectors, and the make-busy jacks and lamps associated with markers, marker connectors, and registers, are located on the master test frame.

NOTE: When an office is equipped for unattended operation the alarm circuit will be under the control of the alarm sending circuit.

LONG TIME OUT MARKER CONNECTOR ALARM

- 6.05 If in response to a major alarm, an LIMC lamp is lighted, it indicates that:
- (a) The marker connector may have failed to connect to a marker during an interval of approximately 7.5 seconds.
 - (b) The marker connector may have failed to release during an interval of approximately 7.5 seconds.

NOTE: The BAT key on the master test frame must be operated to light the marker or marker connector lamps. Marker or Marker connector lamps will light during the hold period necessary to set up a call, usually a fraction of a second. With the

BAT key operated the lights are continually flashing on and off depending on the office load. For this reason a steady light is associated with a trouble condition.

- 6.06 Momentarily operating the MC-AR (marker connector alarm release) key should silence the alarm.
- 6.07 If a LLMC, connector lamp is lighted and the AMB (all markers busy) and MBA (all markers busy alarm) lamps are also lighted it is an indication that all markers were busy and connection was not made to a marker.
- 6.08 If this condition exists momentarily operating the AMB-AR (all markers busy

alarm release) key should extinguish the AMB and MBA lamps.

- 6.09 If not marker busy alarm is sounded but the marker connector fails to connect to a marker, the trouble may be due to failure of the transfer feature to function.

- 6.10 If a marker connector was connected to a marker, but failed to release the marker, the marker would time out and cause a trouble record to be taken. The trouble may be caused by failure of the marker to disconnect battery from the MS relay or may be due to failure of the TRL relay of the marker connector to perform its functions.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

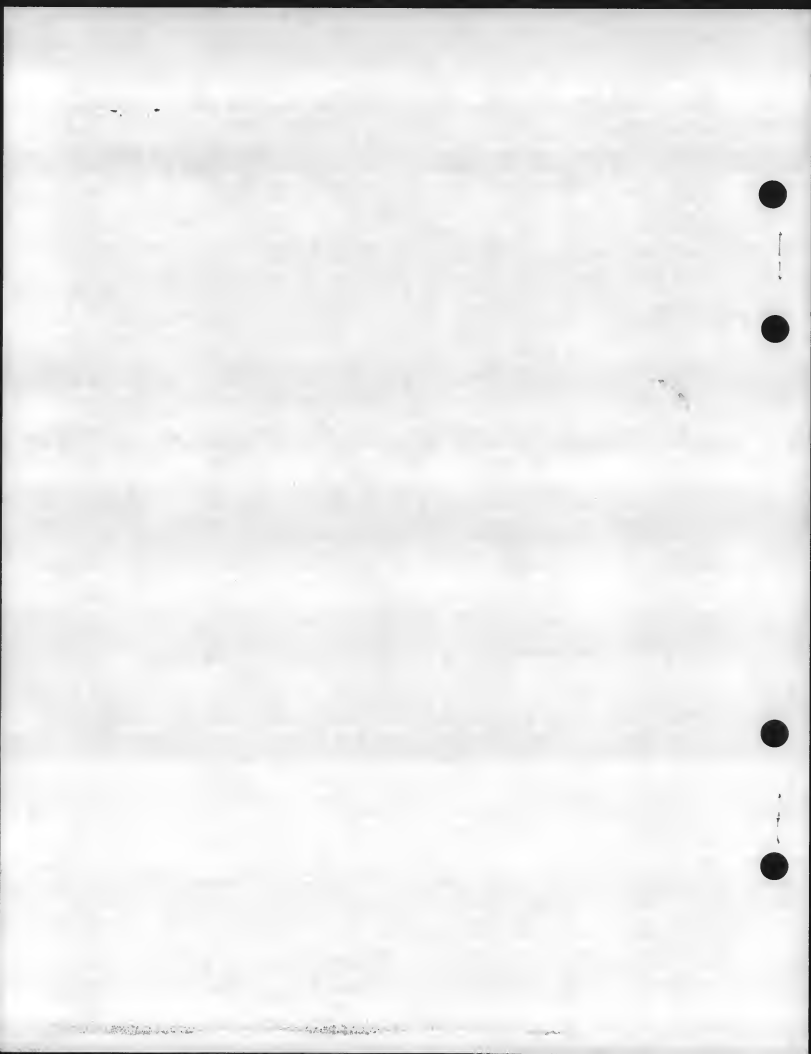
D.1 Circuit Note 105 is changed to indicate that a max. of 9 select magnets may be operated over any SM-

lead, where the lead resistance is a max. of 25 ohms.

D.2 Circuit Note 102 is changed to provide "ground start" for long loop lines associated with PAXs, and to exclude long loop coin lines.

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DEPT 5611-KWH-MFF-PB



CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

CHANGES

D. Description of Changes

D.1 Various notes are changed to reflect a specific type of automatic intercept service.

D.2 A standard method is provided for expanding an existing 190 or 240 line link frame to a 290 line link frame size using split 50 and split 100 supplementary frames.

D.3 The 490 size line link is included in F8105 to correlate with F8101.

F. Changes in CD Section

F.1 Under SECTION I, 2. FRAME LAYOUT change the second sentence of 2.09 to read as follows:

Expansion of the 190 line or 240 line size to a 240 line or 290 line size, respectively, is accomplished by using a split 50 supplementary frame, while expansion of the 190 line to a 290 line size is accomplished by using a split 100 supplementary frame.

F.2 Under SECTION I, 2. FRAME LAYOUT, change the first sentence of 2.10 to read as follows:

Not more than nine select magnets shall be operated in multiple.

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CROSSBAR SYSTEMS
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LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

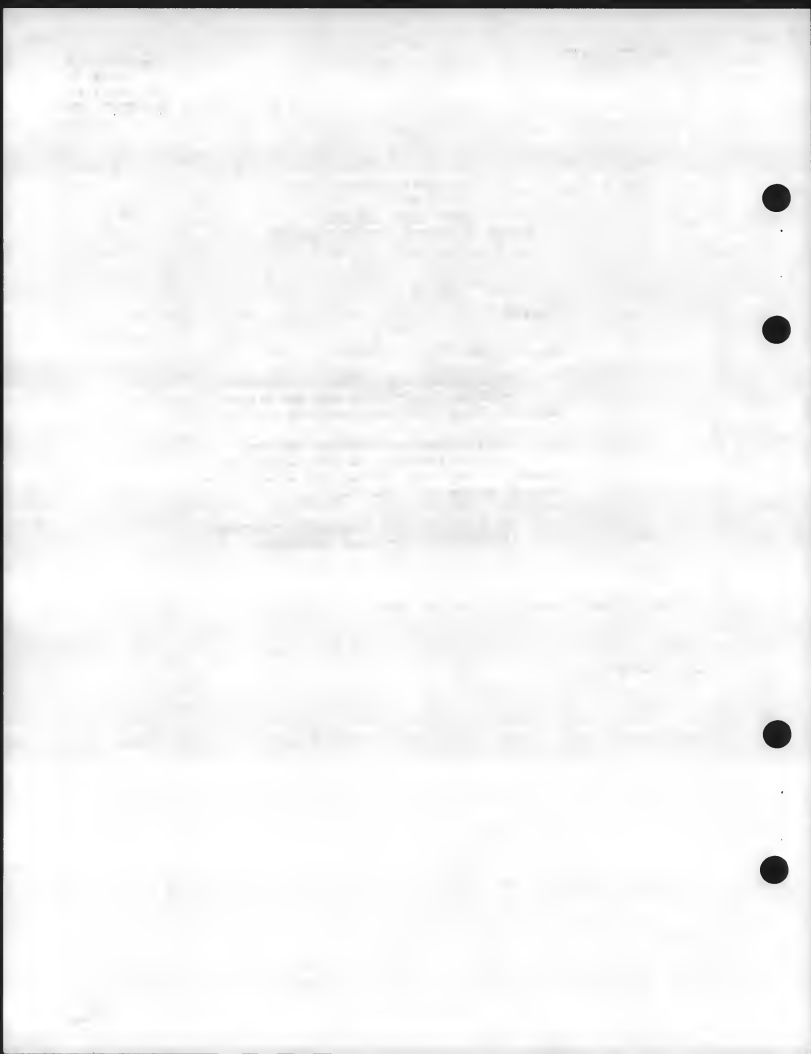
CHANGES

D. Description of Changes

- D.1 This change adds leads to the calls-waiting link circuit and the calls-waiting circuit for calls-waiting service.
- D.2 This change incorporates improved channel testing from the master test frame. A new relay, diode, and network have been added for this feature.
- D.3 A change is made to clarify ordering information for range extension.

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DEPT 5611-HAS-MFF-BA



CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

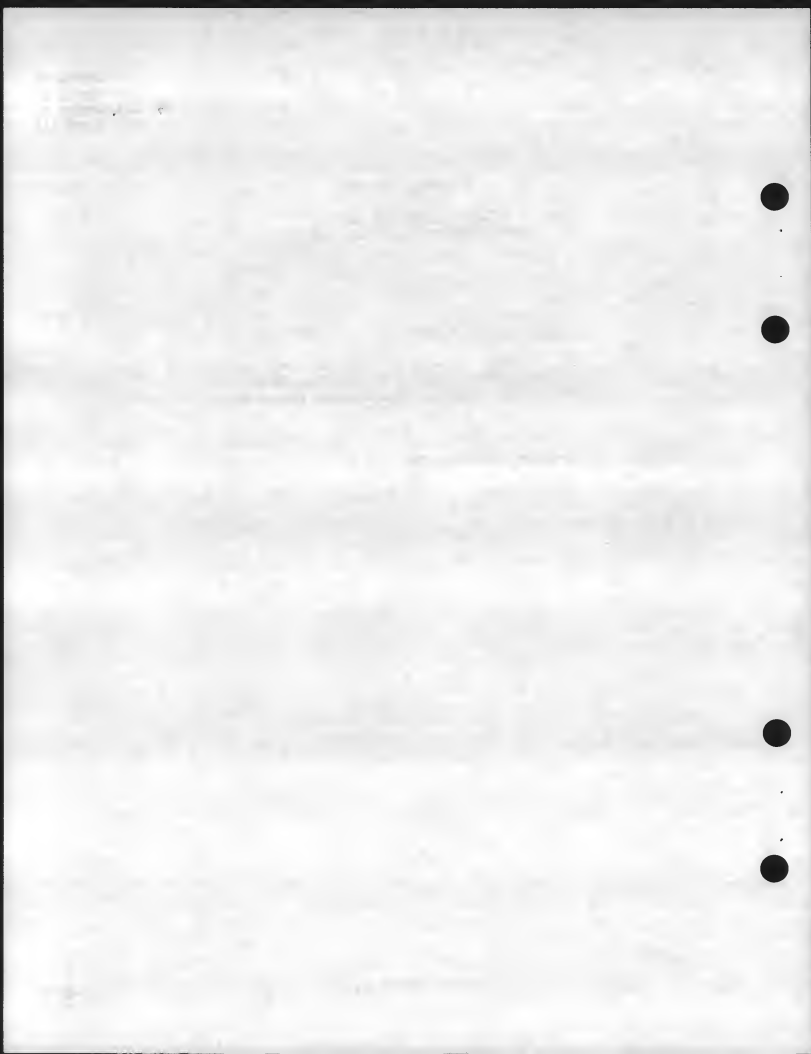
CHANGES

D. Description of Changes

- D.1 A change is made to show the leads and
apparatus required for testing line
circuits for centralized attendant operation.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5611-DLK-REC-RM



CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

CHANGES

D. Description of Changes

- D.1 Networks HGT 0-9, option ZW, are rated Mfr Disc. since there is difficulty in connecting the pigtail networks to terminal strips on the frame. Standard option ZV will be used on all circuits prior to Issue 25D with the necessary equipment needed for mounting the amplas unit.
- D.2 The note for the multiple on the IM lead is revised to read "To maximum of three other circuits associated with same master traffic control," since two master traffic control circuits are provided in offices having more than four wire spring dial tone markers.
- D.3 Clarification for CAD 7 is made regarding the association of line link frames with master traffic control units when dial tone markers are graded for increased marker capacity.
- D.4 A change is made to provided call-waiting link circuit access to the no-test vertical.
- (a) Leads T, R, S, H are shown as stub leads to the call-waiting link circuit.

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DEPT 5611-DLK-RBC-RM



CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

CHANGES

D. Description of Changes

D.1 Option YD, Standard, and option YC, Mfr Disc., and Circuit Notes 118 and 119 are provided for the feature to increase Unigauge flexibility for large switch line links.

(a) Option YD with option YC removed permits operation of either long loop or short loop lines from any vertical group within a horizontal group equipped with range extension for Unigauge cabling.

(b) Prior to Issue 33D, option YC was part of option ZN.

F. Changes in CD SECTION II

F.1 Change 1.12 to read as follows:

1.12 If the line link circuit is arranged for range extension, each horizontal

group or groups equipped for range extension will operate an NLL or LOL relay in series with the line group LG- relay.

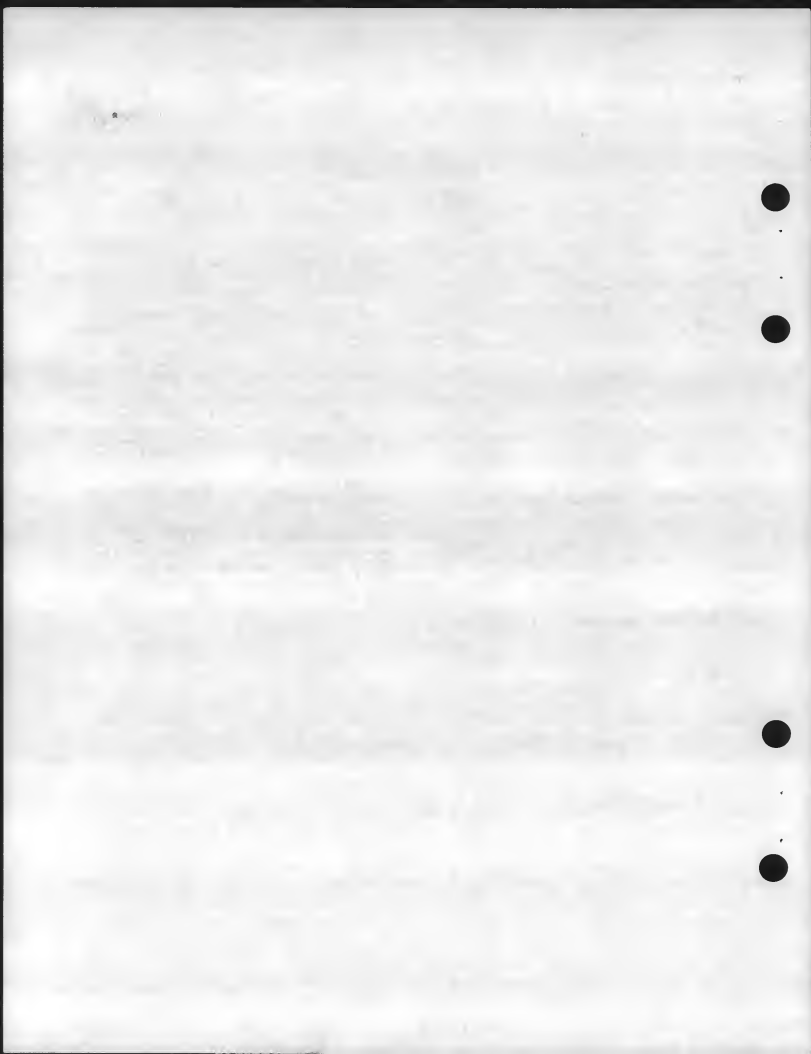
(a) Option YC (Mfr Disc.) - Within a horizontal group equipped with range extension, line groups LG00-C2, and 06-11 can only work with long loop lines. Line groups LG03-05 can be cross-connected to work with either long or short loop lines.

(b) Option YD (Standard) - When option YD is provided, all line groups LG00-11 within a horizontal group equipped with range extension can be cross-connected to work with either long or short loop lines.

If any one of the line groups LG00-11 is cross-connected to work with short loop lines, all lines in that line group must be short loop lines. Ground extended to the marker through NLL or LOL relay contacts in the line link indicates to the marker if it is working with a long or short loop line.

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DEPT 5141-DLK-RBC-GW



CROSSEAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONNECTOR CONTROL CIRCUIT

CHANGES

D. Description of Changes

D.1 In FSL2 leads T3 and R3 are redesignated E and M, respectively, to avoid confusion with the cabling of these leads to the master test frame jack, lamp, and key circuit.

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DEPT 5141-DLK-RBC-PK



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CROSSBAR SYSTEMS
NO. 5
LINE, LINE LINK AND
MARKER CONTROL CIRCUIT

CHANGES

D. Description of Changes

- D.1 Connecting circuit information for CAROT-ROTL testing is provided.
- D.2 Connecting circuit information to the wideband link circuit is redesignated as the 2-way line link pulsing line circuit for wideband service.
- D.3 Miscellaneous changes in CAD 25 and CAD 7 are made for lead TST.

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DEPT 5141-DLK-WHS-JF

